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THE CLASSIFICATION OF CLIMATES[1]

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Foreword by Lois Olson

The establishment of the Bureau of Geography, Meteorology, and Hydrology within the Department of Agriculture in Mexico initiated a period of rapid progress in climatologic research directed specifically toward the service of agriculture. To a large extent this great modern movement is due to the efforts of one man, Alfonso Contreras Arias. Beginning with the problem of climatic classification, he has branched out into other phases of applied climatology, but all of this subsequent work has been fitted into the framework of climatic types.

Contreras began by introducing Mexican climatologists and agricultural workers to the broader aspects of climatic classification. This was followed by objective discussions of the three systems of climatic classifications that have received world recognition—those of Köppen, de Martonne, and Thornthwaite.[2] The final article of the series contains Contreras' own views on the question of climatic classification. Because he has stated extremly well the limitations of all existing classifications and has indicated the direction that must be followed if improvements are to be made, the entire article has been translated in order to make it available to climatologists in this country.

In the previous articles, an effort was made to explain the climatic classifications of Köppen, de Martonne, and Thornthwaite. These three are actually the only systems of classification that have received universal recognition and have been used widely in both general sources and included climatic descriptions in various published works on geography, ecology, economics, etc., throughout the part of this century already past.

It now seems appropriate to analyze briefly the problem of climatic classification in general, and specifically in relation to these three systems. The Köppen system, which initiated a new era in climatology, as has already been said, was used in all the earlier serious works of modern geography, notably in those describing various regions of the world. That of de Martonne—especially the application of his "index of aridity"—has been used generally for descriptive purposes until recently, when the Thornthwaite system gained favor so rapidly that it is used almost exclusively in recently published foreign works on geography, ecology, and agricultural economy.

Naturally, as a system of classification advances farther into the field of science, attacking the problem of quantitative measurement (preeminently the goal of all scientific disciplines) the methods of classification become complex through the use of formulae and concepts that are more or less complicated for the average man. Although actually preferred by men of science, the application of the final method, of necessity, lacks the popularity accorded its predecessors because it requires specialized training. In our country it is the system of de Martonne—modified several times in different ways—that has been applied most widely, and the terminology employed by that author to designate climatic types is found in geography texts and in the writings in other fields related to climate. According to our belief and for reasons that will be explained later, it is the least satisfactory of the three systems for showing the relation between the different regions of our country and the rest of the world—which is the goal persistently sought after.

Classification implies not only the differentiation between two or more objects or phenomena but also, after the whole has been divided into established groups or classes, the coordination of these classes into a scheme that shows their origin or relationship. To say that the climate of our "Bajío" region is different from that of the "Corn Belt" of the United States is only one step; it is necessary thereafter to state the nature and degree of the differences between the two, in relation to accepted criteria, in order that we may describe on this basis, for example, their relative habitability for man. If, on the other hand, we simply call the climate of the central plateau of Mexico the "Mexican climate" or that of the Gulf of Guinea, the "Guinea climate," we will in reality be ignoring the fundamental problem even if we subsequently describe each climate in detail. A simple description of a climate in terms of meteorological data cannot lead to conclusions regarding its potentialities for agriculture, forestry, settlement, etc.

According to the system of de Martonne, only where reference is made to the limitations on available moisture by means of the "index of aridity" is anything resembling classification established. But neither in the general scheme of classification nor in the fundamental bases for the system can a definite explanation of this factor be found (especially as far as temperature is concerned) except, by chance, in a vague way. On the other hand, the systems of Köppen and Thornthwaite, beginning with the concept of favorability for plant life, differentiate clearly between different types of climate on a numerical scale.

Climatic types may be established either in relation to a climatological element which is considered most important or in relation to the effects already imposed by climate on plants, animals, or soil. On this basis a distinction might be made between "pure" climatology and "applied" climatology.

But a sytem of classification that is limited strictly to the field of pure climatology, that is, one in which all relations between climate and the resulting edaphic and ecological phenomena are excluded for the division of climate into types, would be absolutely artificial and valueless, since it would be based solely on arbitrary series of physical data. Actually there has been no system of this type. Theoretically, at least, the many systems of climatic classification that have been developed during the passage of time have sought out and attempted to exploit the relations that exist between the distribution of various elements of climate and other phenomena. In the first climatological zonation of the earth by Supan, the annual isotherm of 20° C. and that of 10° C. for the warmest month of the year were selected as boundaries between the hot, the temperate, and the cold zones corresponding to the general distribution of plant life. If any single criterion can be accepted as the most general, it is favorability for plant growth.

[1] Translated by Lois Olson from *Agricultura*, vol. 2, No. 14, pp. 17–24, 1939.

[2] Contreras Arias, Alfonso. "La clasificación de los climas," *Agriculutra*, vol. 1, No. 1, pp. 16–18, 1937; "La clasificación según Köppen," *Agricultura*, vol. 1, No. 2, pp. 6–13, 1937; "La clasificación según de Martonne," *Agricultura*, vol. 1, No. 4, pp. 34–42, 1938; "La clasificación según Thornthwaite," *Agricultura*, vol. 1, No. 6, pp. 8–12, 1938.

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The selection of the existing state of the soil, as a basis for determining climatic classes or types, offers many very serious difficulties. Among others are those derived from the mutual relation between the climate and soil and the lag in the response of the latter to climatic forces in its process of evolution. On the other hand, animal life, especially human life, while basically controlled by the forces as a whole, is removed to a large extent from the influence of climate in many ways, thus making highly complex the problem of determining the direct effects of climate. However, authors of systems of climatic classification have claimed, explicitly or implicitly, that their climatic types correspond with the types of natural vegetation that predominate in the corresponding geographical regions. This is the source of expressions such as steppe climate, desert climate, taiga, etc.

Carrying this idea to an extreme, it might be concluded that the climatological conditions peculiar to each region, as related to favorability for plant life, might be best expressed by the very existence of different plant types, without requiring the expression of these conditions through meteorological data. The different types of climate would be characterized on the basis of different types of plants. Raunkiaer, the Danish botanist, has attempted a classification of this nature.

The fundamental basis of this classification is the nature and degree of protection that the plant displays during the unfavorable season in its terminal buds, lateral buds, shoots, or other organs destined to continue its life on the return of a favorable season. During the season that is unfavorable—because of either temperature deficiency or insufficient moisture—this vegetative organ remains in a state of dormancy, ready to resume active growth when the combination of climatic factors again becomes propitious.

The 10 types or forms of plant growth distinguished are shown below (the symbol used for designating each is enclosed in parentheses):

1. Succulent stem (S). Stems fleshy or juicy.
2. Epiphytes (E).
3. Megaphanerophytes and mesophanerophytes (MM). The megaphanerophytes are trees more than 30 meters tall, whereas mesophanerophytes are trees 8 to 30 meters in height. As the terminal buds of both are freely exposed the two types are considered together.
4. Microphanerophytes (M). These are small trees or shrubs with heights of between 2 and 8 meters.
5. Nanophanerophytes (N). Shrubs of less than 2 meters in height. (The trees and shrubs can be designated jointly as phanerophytes.)
6. Chamaephytes (Ch). These are plants that have their terminal buds situated at the surface of the soil or just above it, in such a manner that in regions where it snows they are protected by snow in winter and in regions where drought is the unfavorable factor the dried-out parts of the plants, which have died down to the soil, provide some additional protection. Thus the buds are better protected than among the phanerophytes. Creeping plants and "cushion plants" belong to this group.
7. Hemicryptophytes (H). These plants have dormant buds just below the surface of the soil, and upon the death of the part exposed to the air, the herbaceous part, in the unfavorable season remains in a dry state above the soil, providing additional protective covering.
8. Geophytes (G). In these the part of the plant that can remain dormant is subterranean. They are plants with bulbs, rhizomes, etc.
9. Helophytes and hydrophytes (HH). The former are swamp plants, with their terminal buds at the bottom of the water or in the soil just below. Hydrophytes are aquatic plants with rhizomes.[3]
10. Therophytes (Th). These are plants that do not remain alive after the onset of the unfavorable season, except for the seed; that is to say, the plants are annuals. The geophytes, helophytes, and hydrophytes.

[3] In ecology and plant geography, the term "hydrophytes" ordinarily has a broader meaning than that assigned to it by Raunkiaer. They are plants normally requiring great humidity, even though they do not specifically live in water.

Even though this author has practically ignored the lower forms of plant life (algae, fungi, etc.) his system is of considerable interest. Outside of the two first groups (plants with succulent stems and the epiphytes) with definitely characteristic peculiarities, the remaining groups, beginning with the phanerophytes, form a series in which each vegetal type has its terminal buds better protected than those of the preceding group.

In order to determine the favorability of the climate of a region according to Raunkiaer's system, a list must be made of the different species of plants occurring within it. After classifying these according to the groups mentioned above, the percentage belonging to each group must be calculated. For a given region, the term "biological spectrum" is applied to the table of values arranged in conformity with the vegetative groups already mentioned. This spectrum will be compared with the normal spectrum, which is assumed to represent average conditions for the world as a whole.

The normal spectrum, according to Raunkiaer, is as follows:

S.	E.	MM.	M.	N.	Ch.	H.	G.	HH.	Th.
1	3	6	17	20	9	27	3	1	13

If a local spectrum, for example, shows a predominant percentage of type H (Hemicriptophytes) in comparison with the normal spectrum, the climate of the locality will be termed "hemicriptophytic"; if in another the percentage of groups G and HH in the spectrum is markedly higher than in the normal spectrum, the climate will be termed "criptophytic," etc. The climate which, through dryness, for example, supports only annuals would be "therophytic" in the extreme.

Theoretically this method is above reproach on an ecological basis, provided this is the accepted approach to the problem, since the classification is based on degree of climatic favorability. In application, it is not satisfactory for some parts of the earth because of the inadequacy of our knowledge of geographical botany. It presupposes minutely detailed knowledge of the flora of each place, which is not available in the majority of cases; nor is it to be anticipated that this detailed knowledge can be obtained quickly, considering the arduous labor that it entails. From the climatological viewpoint it does not fulfill the purpose of a system of classification, which is to make possible ready comparison of the climate of certain regions with that of others by means of a fixed scale of values—preferably numerical—that permits direct study not only of the effects of climate on the vegetation but also upon animals, soil, etc. For this reason, among others, Raunkiaer's system has not been widely employed up to the present.

Of the systems of Köppen, de Martonne, and Thornthwaite, that of Thornthwaite has the additional advantage of attacking the concept of favorability for plant life by using a numerical method for expressing the degree of favorability in respect to both thermic and hygrometric conditions, thus establishing two scales of progressive values which seem in accord with the characteristic progression in nature. Moreover, the four elements or factors used to define each climate (humidity, temperature, distribution of rainfall throughout the year, and the yearly temperature variations) are presented clearly, showing the importance and scope of each of these and permitting rapid improvement leading towards ultimate perfection, either quantitatively or through an increase in the number of groups or types recognized.

The basic factors of *all climate* are these four, and Thornthwaite's merit consists essentially in his having devised a simple and rational method for classifying them.

But let us not exaggerate the possibilities of this system. Climate is unique because, in the first place, it helps us differentiate between one region and another of the earth's surface and is a very complex combination of characteristics. It is this circumstance that gives an impression of an almost infinite diversity of climates. Aside from those we have already mentioned, there are other very significant characteristics that have not been considered in the scale of classification we are discussing.

One of these is the magnitude of the diurnal range of temperature, which in the technical terminology of climatology is called simply the daily range or oscillation in temperature. Or it may be described as the difference occurring within a 24-hour period between the highest temperature (usually registered in the early afternoon) and the lowest temperature (commonly registered about dawn). This variation is of major importance to plant life and is unrelated to the annual march of temperature. I might add that there are climates in which the diurnal range is very great although yearly temperature variation (judged on the basis of noonday or average monthly temperatures) is so small that thermic seasons cannot be distinguished. This occurs within the Tropics, especially in dry regions. In humid regions the clouds, and even the water vapor in the lower layers of the atmosphere, reduce notably the variations in temperature. But in dry regions, in which the nights generally have clear skies, the loss of heat by the soil and by the adjacent air is extremely rapid, with results of great importance. In the first place rapid cooling is a hazard to plant life, even killing it in the case of black frost. It has been proved that without noticeable injury plants resist changes of temperature much greater than that registered during frosts, provided these changes occur slowly. However, what seems to be most damaging to plants is the rapid rise of temperature following a night which is very cold after sunset.

Aside from this direct effect of the diurnal range of temperature, the condensation of the vapor in the atmosphere caused by nocturnal cooling must be considered. If the atmosphere is not extremely dry, as the temperature of the air becomes lower, the water vapor reaches the temperature required for condensation, which takes place in the form of dew if the temperature is above 0° C. This is a very frequent occurrence during the winter throughout the Tropics even in high altitudes. The soil and plants in this way receive unrecorded moisture, which sometimes is considerable. As a result, some regions that seem to be extremely dry, on the basis of amount of precipitation received, are not in reality so dry and can support plant life that would perish if it depended upon rainfall alone.

The manner in which the rain falls is another factor that affects the amount of moisture in a given area. This is not considered if the data available are based solely on the amount of water recorded by a raingage. A violent storm does not have the same effectiveness as a long continued gentle rain, even though the total amount of water received might be the same in both cases. Precipitation in the form of snow also behaves differently. A gentle rain provides the maximum amount of available water in the area in which it falls and a minimum amount of run-off to other areas. The opposite is true of a heavy storm; and this not only reduces its value in the area where it falls but also converts it into a serious agent of destruction for the delicate parts of plants and the vegetative cover of the soil.

From the standpoint of plant life another important difference between regions of the earth's surface is the intensity and distribution of solar radiation through time. As climate is defined meteorologically, considering only the characteristics of the atmospehere, solar radiation is not taken into account except as a factor upon which the temperature of the air depends. It is not considered in relation to its direct effects on soil, plants, animals, etc. In the general concept of climate, however, this factor is usually included. Thus, for example, it is included when the factors that comprise the climate of one or another region are mentioned in relation to the curing of certain ailments through the direct action of sunshine. In climatological tables, data concerning the number of hours of bright sunshine and the intensity of solar radiation itself are ordinarily included.

For a plant whose nourishment depends upon photosynthesis, which is generated through energy received directly from the sun, not only the total amount of energy that it receives during its life cycle but also the manner in which solar radiation is distributed through time is of major importance. In this connection there is a marked difference between conditions in the intertropical zone and those of higher latitudes. The length of the solar day in the Tropics varies but slightly during the year, while in higher latitudes, even if we consider only those known as the "middle latitudes" (35° to 50° in the Northern and 30° to 40° in the Southern Hemisphere) this variation is marked. During the season of heading and ripening of annuals such as the cereals, the radiation received in the Tropics is very intense but is limited by comparatively short days; in the middle latitudes, however, the radiation is less intense per minute but continues during a greater number of hours per day. The effects of this difference in the distribution of solar energy on the anatomy and physiology of plants, however, has not been studied adequately; but everything indicates that it is principally responsible for the differences encountered in the hardiness and composition of the grain when the same variety is cultivated under otherwise similar conditions in inter- and extra-tropical regions.

Although we have mentioned daily variation in temperature, moisture, and solar radiation, it seems that, aside from the different variations in temperature throughout the year, there are other important differences between climates which through quantitative measurement would be of use in a system of climatic classification. Unfortunately, in none of the three systems mentioned are these elements employed, nor do they appear in any other that is known. De Martonne, in describing the characteristics of intertropical types (which in his general scheme of classification are included in the group of "hot climates"), refers to the daily range of temperature but without presenting any method for quantitative measurement or even for formulating an opinion about its relative importance.

Authors, adhering firmly to the meteorological definition of climate, do not refer to the intensity and distribution of solar radiation, leaving these factors for consideration in special studies.

There is also another climatological factor of great importance which, to date, has not been taken into consideration in a general classification of climates—namely, variability. The group of factors considered representative of a region describes conditions which occur over a period of many years, those which have been represented most frequently in the region. However, in any selected year, actual conditions diverge more or less from this representative climatological type.

It would be of no great importance if the divergence from the normal type were small (with negligible effect on plant life, for example) or of more or less the same magnitude in different parts of the world. But there are great contrasts in this respect which begin to emerge as soon as a practical expression is given through the climatographic isolation of any part of the earth's surface. From the agricultural viewpoint, for example, climatic variability is one of the factors that should be considered of primary importance in estimating the potentialities of a region. The variation in the yield of a cultivated plant from year to year is subject more to the meteorological conditions that occur during its growth than to any other factor. Man, striving to improve his living conditions to the best of his ability, has been obsessed with the idea of crossing and selecting in order to produce varieties especially resistant to the adversities most frequently encountered in each region. In those regions where the same type of adversity occurs from year to year, the variety that is distinguished by its resistance to it is best acclimated and of greatest value because of its productivity. By contrast, in places where the hazard varies from one year to the next (or from some years to others), having, for example, insufficient moisture at some times and excessive moisture at others, the prospects of improving any variety of plant are much smaller, and the yields vary greatly from one year to another.

In cases where the climate of a region is expressed numerically, as through the Thornthwaite indices, one method that at first glance seems capable of avoiding this pitfall would perhaps be the indication along with the value of each index number of another value such as "average deviation," "typical quadratic deviation" (or "standard deviation"), "total range of variation," etc., using statistical methods to qualify the distribution or variability of a series. But the problem, considered from the viewpoint of plant life, is not so simple because there is no guarantee that the magnitude of the meteorological variations used is in proportion to the resulting effect on plant life.

Finally, just as the concept of climate in relation to time implies the idea of persistence, so in relation to space it implies the idea of definite, limited extent. When we consider climate we inevitably associate the idea of a definite combination of factors with a specific area more or less extensive; in this way we say the "climate of the coastal region," the "climate of this part of the plain," the "climate of that valley," "the climate of this city . . ." Recently the term "climate" has been applied to a combination of certain factors that are limited to an area of very small extent, and thus a specialized branch of research has been created—microclimatology. Microclimate, according to Geiger, is interpreted as the climate of an infinitely small area.

According to our ideas, this undue extension of the concept of climate is only one of those extremes induced by the exaggerated spirit of generalization that is frequently encountered among certain scientists. To speak of the climate of an infinitely small space seems simply absurd.

But in all cases there is the problem of qualifying the degree of precision so that the type of climate recognized as representative of a geographical region satisfies the climatological factors that can be distinguished within it. Let us consider the simplest case, such as that of an extensive plain where representative statistical data and the general factors of the climatic regime (such as "average annual temperature," "the annual distribution of rainfall," and "the annual march of temperature") are approximately the same for all points. Even in such a region some places will differ from others because of different soil composition, or because of differences between eroded soil and soil covered with a mantle of vegetation, etc. These differences are responsible for phenomena that may be of great importance locally, especially for plant and animal life. The most important of these phenomena are, certainly, those arising from the different rates of heating and cooling of the lower layers of the atmosphere from place to place during the day. The "daily range of temperature" of the layer of air next to the soil cannot be shown in a regional type of climate even though it probably has greater local significance than any other factor.

In reality, the problem is far more complicated since the areas regarded as geographic units in works of climatography do not have the uniformity assumed in our example; but within them are to be found topographic unconformities that cause deviations from the general climatic type of the region. Consider now the results of difference in exposure to the rays of the sun, as demonstrated by the slopes of a single hill; the variations derived from the orientation of a ravine or the character of a valley; and finally, the effects produced by the nearness to woods, a lake, a city, etc.

In view of the great complexity of the question, doubtless it is evident that there is reason to undertake at least three distinct types of study: That concerned with the climatic character of the geographic region; that concerned with topographic diversities; and that concerned with local differences arising from the specific nature of the soil, its vegetative cover, etc. Consequently, three terms have been suggested to designate the climatological purport of each type of study: Macroclimate, mesoclimate, and microclimate. *The relative importance of macro-, meso-, and micro-climatology depends upon the practical purpose for which each is destined.* The geographer and, to some extent, the economist usually undertake macroclimatic studies. For the farmer, the ecologist, and soil scientist, meso- and micro-climatic phenomena are of greater importance.

What boundaries can be drawn between macro-, meso-, and micro-climatology? It is an open question, and the few works published to date comprise a medley of widely diverse concepts, so much so that it is difficult in some cases to see clearly the fundamental ideas of the authors.

The limits between concepts of macro-, meso-, and micro-climate, with reference simply to areal extent of land over which a climatic type is valid, as proposed by Scaëtta, remain supremely vague. Geiger and Schmidt suggest that the distinction between meso-, and microclimate be made on the basis of instrumental technique. When the phenomenon to be studied requires special placing of thermometers, differing from that used in ordinary meteorological observatories, the phenomenon would be of a microclimatic nature. For example, a study of cooling like that experienced in the layers of air near the ground requires the exposure of themometers at specified elevations above the soil, in addition to the usual meteorological shelter. This investigation would be microclimatological; as also would be those studies requiring, for example, the use of a thermometer of great sensitivity (e. g., thermoelectric), or the use of a hot wire anemometer in place of an ordinary anemometer for measuring the movement of the air. Finally, according to Remp, it is degree of persistence or immutability that distinguishes the three types of climate. Variability of climate increases as the space considered is restricted. Regional or macroclimate, which is determined by geographical position, including general orographic features (altitude, situation in relation to a mountain range, etc.), has the highest degree of stability. Mesoclimate is less stable since it lies within a macroclimate and since it is determined by topographic features of the earth or by the influence of large areas with different land conditions, such as extensive woods, swamps, the buildings of a large city, etc. At times it can even be modified artificially: A swamp can be drained, the exposure of a slope may be improved by proper terracing, a valley or ravine may acquire protection through the growth of woods, a city may expand greatly, etc. In the case of microclimates, the climates are essentially lacking in stability since they depend on purely local features, among which minor details of topography, of the evolution of a natural vegetation cover, of the activities of farmers, etc., play an important role.

We do not pretend to make even a more or less complete review of the various aspects of this question. Such a procedure would be beyond the purpose and scope of these articles. However, we believe that what has been said is enough to indicate the great difference that exists between the different climatic characteristics of a given area. Certain individual characteristics may be classified as macroclimatic, mesoclimatic, and microclimatic, and the distinction has much greater transcendency than appears at first. But even if mesoclimate is subordinate to macroclimate, and microclimate in its turn to mesoclimate or to macroclimate directly, the validity of the climatic data, the techniques that should be used in securing them, and the use that may be made of them depend upon an understanding of current geographic, topographic, and local site factors upon which they depend.

For example, the intensity and frequency of frost, although of great importance to the farmer, are of a microclimatic order or at least mesoclimatic. Anyone who has observed this phenomenon in the fields knows that because of minor topographic variations there are often great differences between one area and the next: the sinking of cold air, the local mobility of the lowest layers of the atmosphere, the humidity of the layer of air in direct contact with the soil, etc., at the exact moment when cooling takes place. Even within a single farm of moderate size, the farmer knows that some places are more subject to frosts than others. From this it is clear that on a general map of a country as fitful as ours, on a scale in which not even major topographic features are perceptible, the demarcation of areas of real value to practical farmers, for example, could not even be attempted.

The records of wind direction and velocity that are made at many of our observatories are also elements whose use requires much interpretation since, considering the low elevation above the soil at which our wind vanes and anemometers normally have to be installed, their records are of mesoclimatic order. Consequently, even though they show the actual movement of the air in a locality, their records may not conform—especially as far as direction is concerned—with the movements of the great masses of air that invade the Republic and upon which, climatologically speaking, the various phenomena that characterize the seasons depend.

The systems of classification used up to the present are of macroclimatic type. Possibly to distinguish between mesoclimates and microclimates, other methods, using totally different elements, may be needed. As the factors that should be considered as fundamental become more restricted areally, the criterion for judging the methods, the units, and the data would differ radically, at least in the case of microclimates. In these we decide individually what information is *indispensable* to accomplish the practical purpose for which the study was designed (phytoecology, zooecology, edaphology).

The system of Thornthwaite, although devoted like the others to the differentiation of macroclimates, has advantages because the macroclimates are derived directly from that concept which, as we have already said, serves both as a starting point (favorability for plant life) and as a method of classification through progression of values. From this it becomes evident that the system might be extended to include the description of mesoclimates by means of modifications and amplifications which do not effect substantially its fundamental principles.

From what we have said, it will be understood that the actual application of the general methods of climatic classification cannot do more than delineate the macroclimatic regions of a country. To complete the climatological description it is necessary to describe with more or less detail the characteristic mesoclimatic features in the different parts of each of the macroclimates or at least to point out those factors that create such variations. As for microclimatic features, their study belongs obviously to applied climatology and for this reason remains subject to the purpose and criterion of the investigator in each individual case.

The territory of the Mexican Republic has characteristics that are truly unique from a climatological standpoint: Its geographical position, to a large extent tropical; its orographic diversity; to the south of the volcanic range, its position as an isthmus between two seas with different conditions of temperature and ocean currents; its proximity to a tropical cyclonic region as important as that of the Antilles. All these factors, working together, create sharp climatic contrasts within the country and make its climatic division extremely difficult. It is necessary, therefore, to bear in mind the ideas that have been propounded in this brief paper not only in constructing a climatic map but more especially in using such a map as a basis for drawing conclusions for application in other investigations. This is particularly important when the nature of an investigation undertaken requires the evaluation of the relative importance of various types of climatic data.

Since the Thornthwaite system of climatic classification seems to be in reality the most convenient, as much because of its intrinsic qualities as because of its general acceptance throughout the world, we have constructed in the Institute of Geography of the Secretariat of Agriculture and Development a new climatic map based on this system. This has been entitled "Map of the Climatic Provinces of the Mexican Republic" and is actually in press.[4] The macroclimatic nature of the study is shown by the title and in the accompanying text we have tried to show the major mesoclimatic factors that can be distinguished in each province. We propose, furthermore, to study later the microclimatic subdivisions of each of these.

The new map, however, differs from the part of Thornthwaite's world map [5] that relates to our country and upon which our plan is based, because all currently published data have been used as well as Thornthwaite's fourth element of classification (the annual march of temperature) in arriving at the cartographic divisions. This latter is an element that even Dr. Thornthwaite himself has been unable to show on his map—because of cartographic difficulties, as he explains in his text—but also an element of greatest importance for the climatic divisions of the country.

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[4] This map, on the scale of 1:5,000,000, was recently published by the Secretaria de Agricultura y Fomenta in a bulletin entitled *Mapa de las Provincias Climatológicas de la República Mexicana* (Mexico, D. F., 1942) and is accompanied by an explanation of its construction and by a comprehensive series of climatological tables giving the data upon which the map is based.

[5] See Agricultura vol., No. 6, pp. 8–12, 1938.